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AUTHOR Anderson, Melissa S.; Louis, Karen Seashore
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ABSTRACT

This study examined the extent to which graduate students in science and engineering fields subscribe to the norms of research behavior which have been the basis of the freedom, self-direction, and self-regulation which characterize academic research. In particular the study focused on the relationship between academic departments' climates and structures, and the extent to which graduate students subscribe to either norms or counternorms of research. The norms have been defined as universalism (separation of scientific knowledge from personal characteristics), communality (sharing of findings and techniques), disinterestedness (separation of research from personal motives) and organized skepticism (critical, public examination of scientific work). Using a random sample of 2,000 graduate students, 500 each from 4 disciplines (microbiology, chemistry, sociology and civil engineering) from 98 graduate departments, surveys were sent to all by mail and a final response rate of 74 percent was achieved. Analysis demonstrated substantial ambivalence among graduate student about the traditional norms of academic research and also revealed the influence of departmental structure and climate on subscription to the norms. Significant differences were found in the normative orientations of the native versus international students. Included are six figures and 14 references. (JB)

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Subscription to Norms and Counternorms of Academic Research: The Effects of Departmental Structure and Climate[1]

Melissa S. Anderson
Karen Seashore Louis

University of Minnesota

Paper presented at the Annual Meeting of the Association for the Study of Higher Education, Boston, November, 1991

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Texas A&M University
Department of Educational
Administration
College Station, TX 77843
(409) 845-0393

ASSOCIATION FOR THE STUDY OF HIGHER EDUCATION

This paper was presented at the annual meeting of the Association for the Study of Higher Education held at the Park Plaza Hotel & Towers in Boston, Massachusetts, October 31-November 3, 1991. This paper was reviewed by ASHE and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC collection of ASHE conference papers.

Abstract

The freedom, self-direction, and self-regulation which characterize academic research are founded on assumptions about the collective normative orientation of the professoriate. The validity of these assumptions has been brought into question by scattered observations of counternormative behavior among researchers. This paper examines the extent to which graduate students in science and engineering fields subscribe to the norms of research behavior. It focuses on the relationship between academic departments' climates and structures, and the extent to which graduate students subscribe to either norms or counternorms of research. Data for the study are derived from a survey of graduate students in four science and engineering fields at major research universities nationwide. Our analyses demonstrate substantial ambivalence among graduate students about the traditional norms of academic research, and reveal both the influence of departmental structure and climate on subscription to the norms, as well as significant differences in the normative orientations of U.S. versus international students.

Introduction

The freedom, self-direction, and self-regulation which characterize academic research are founded on assumptions about the collective normative orientation of the professoriate. The validity of these assumptions has been brought into question by observations of counternormative behavior among researchers. This paper examines the extent to which graduate students in science and engineering fields subscribe to the norms and counternorms of research behavior. In particular, it focuses on the relationship between the climates and structures of academic departments and the extent to which graduate students subscribe to either norms or counternorms of research.

Norms and Counternorms of Academic Research

The collegial nature of the scholarly community is often described either in terms of time-enhanced memories of better days or in terms of visions of ideal harmony and altruism. Robert Merton's (1942) classic analysis of scientists' behavior is distinctive, in that it is derived from actual observations of researchers at work. He describes norms of academic research which are not so much ideals as shared working assumptions about the way research is conducted.

Merton makes explicit the normative basis for much of the structure of science. The four norms he identifies as undergirding the academic research enterprise constitute a basis for shared understandings of appropriate research behavior across disciplines and institutions, and a rationale for entrusting the academy with responsibility for the conduct of its own members. While these norms were derived from observations of scientists at work, Clark has noted that "they comprise not only the ethos of modern science, following Merton, but also much of the ethos of the academic profession" (Clark, 1983, p.93). The norms are:

1) universalism, the separation of scientific knowledge from the personal characteristics of scientists,
2) communality, the sharing of research findings and techniques with all other researchers,
3) disinterestedness, the separation of research from personal motives, for the sake of truth and the advancement of knowledge, and
4) organized skepticism, the critical, public examination of scientific work.

Ian I. Mitroff's work casts doubt on the assumption that the traditional norms of research are shared universally, and suggests that new circumstances may be changing the nature of academic work and the customary relationships among researchers. In research on the Apollo moon scientists, he discovered that not only were the norms not operational, but what he has described as

counternorms actually governed the behavior of scientists. These counternorms are, point for point, contrary to Merton's norms (e.g., solitariness instead of communality). Others have argued that competition, political cliques, and incentives built into the academic research structure, among other things, contribute to a less-than-universal adherence to the norms (Goldman, 1987; Ben-Yehuda, 1986; Chalk, 1985).

Despite indications that researchers' behaviors vary from Merton's standards, the norms continue to provide accurate descriptions of desirable, appropriate behavior for academic research. As Rosensweig (1985) puts it:

> ... the picture of working scientists sharing with their colleagues --- and therefore, with competitors --- all that they are learning, as they learn it, is something in the nature of a cultural myth .... Like all myths that are central to a culture, it has a firm basis in reality, but it exaggerates reality in order to serve its real purpose, which is to tell people how they ought to behave, not how they do behave (p. 47).

Socialization in Academic Departments

Since the research university is the site of both academic research and the training of new scientists and scholars, it is reasonable to suppose that researchers acquire their orientations to academic work in part while in graduate school. Socialization to the field occurs through a series of passages, each involving the acquisition of new characteristics of the members of the field (Van

Maanen and Schein, 1979). It is during the long apprenticeship period of graduate study, through contact with faculty and other researchers, that students learn about appropriate behaviors and standards specific to academic research. Professional norms are inculcated largely informally, through observation and discussion.

The climate and structure of an academic department substantially shape the graduate experiences of its students. Here, climate includes such factors as competitiveness, solidarity among students, the degree of collaboration, and other dimensions of work context as experienced by departmental members. Of particular interest here is Victor and Cullen's (1988) work on climates in organizations. They identify five dimensions of ethical work climates: caring, laws and codes, rules, instrumental orientation, and independence.

Structure refers to the balance of formal and informal rules, requirements, activities, and relationships present in a department. Given that many organizational studies have documented the effects of organizational climate and structure on individual behaviors, it is intriguing to consider the effects these factors may have on the extent to which students subscribe to academic norms or counternorms.

Aspects of climate and structure are particularly interesting to examine in the present context, since they not only vary across academic departments, but are susceptible to deliberate efforts at change within a department. An examination of the relationships between organizational factors and adherence to the norms of research therefore suggests the extent to which academic units

participate in the development of an academic ethos based on the norms or, alternately, based on the counternorms.

The mentoring relationship has also been identified as an important aspect of socialization into a field (Merriam, Thomas, and Zeph, 1987; Bragg, 1976). Graduate research involves a learning process that is highly dependent on the behavioral and attitudinal clues provided by significant role models (professors, post-doctoral students, or more advanced graduate students). In addition, professors' vested interest in students' successful socialization is related to the effect on their own and their institutions' prestige of the quality of the Ph.D.'s graduated from their programs.

Research Questions

In the following analysis, we first examine students' overall subscription to Merton's norms and Mitroff's counternorms:

-- To what extent do doctoral students subscribe to the norms of academic research?

-- To what extent do doctoral students subscribe to counternorms of academic research?

We then turn to an analysis of adherence to norms and counternorms in relation to departmental factors:

-- What effect do aspects of climate and structure of academic departments and students' experiences with mentoring have on the extent to which students in those departments subscribe to the academic norms or counternorms?

We hypothesize that aspects of climate and structure which put graduate students in close contact with faculty will increase students' subscription to the norms and decrease their subscription to the counternorms. We also suppose that students who have mentors (not merely advisors) will show greater adherence to the norms and less to the counternorms. Finally, we hypothesize that the longer a student has spent in his or her graduate program, the greater that student's subscription to the norms as opposed to the counternorms.

Data Source

Our investigation uses data collected as part of a larger, ongoing study on graduate education, the Project on Values and Ethical Issues in the Graduate Education of Scientists and Engineers. This three-phase project is funded by the National Science Foundation, through a grant to the Acadia Institute. In the project's first phase, we surveyed the academic deans of major research universities about their institutions' experiences with and policies regarding ethical issues and research misconduct. In the second phase, on which this analysis is based, we surveyed graduate students in research universities about their graduate school experiences. The third phase, currently underway, consists of a survey of faculty members at research universities; the questionnaire asks about faculty members' perceptions of graduate education, and closely parallels that used for the graduate student survey.

Our focus on science and engineering and our interest in disciplinary effects led us to select a few fields from which to sample graduate students. We based our selection in part on the Biglan (1973a, 1973b) typology of academic departments, which is based on three descriptive contrasts: pure versus applied, hard paradigm versus soft paradigm (in the sense of Kuhn, 1970), and life versus non-life fields. Since most science departments fall into the pure/hard paradigm category, we chose two fields from this group: a life field (microbiology) and a non-life field (chemistry). From the applied group, we chose civil engineering (applied/hard paradigm/non-life), and from the soft paradigm group, we chose sociology (pure/soft paradigm/life). The distribution of our chosen fields is shown in Figure 1.

Insert Figure 1 about here

One criterion for our selection of particular fields within Biglan categories was the extent of graduate education in those fields: we chose disciplines in which substantial numbers of doctoral degrees are currently being awarded.[2]

Since we wished to investigate the effects of academic departments on a number of aspects of graduate education, we needed to narrow our sample selection to graduate students in the largest departments in these four disciplines. To do so, we consulted the Directory of Graduate Programs: 1988 & 1989, produced by the Graduate Record Examinations Board and the Council of Graduate Schools in the United States, for the period July 1983 to

June 1986. Given the large size of many chemistry departments, we selected only those departments which awarded 50 or more Ph.D.'s during this period, according to the Directory. For the other disciplines, we chose those departments which awarded at least 20 Ph.D.'s during this period. This procedure yielded 100 departments.[3]

Next, we contacted the chairs of these departments by mail, asking them to provide us with the names and addresses of doctoral students in their departments.[4] As our survey was to be sent out during the fall term, we requested that all first-year doctoral students be removed from the lists, on the assumption that these students would not yet be familiar enough with graduate study to provide informed responses. All but two of the department chairs (one in microbiology and one in sociology) complied with our request.

From the student lists provided by departments, we performed a random sample, stratified by discipline. The resulting sample population consisted of 500 students from each of the four selected disciplines, with each department's sample population proportional to the number of students in that department.

The questionnaire sent to the students in our sample included a wide variety of items relating to graduate education. We asked the students about, among other things, their doctoral programs, their academic and social experiences in their departments, their mentors, and their experiences with ethical issues and research misconduct. The items on the questionnaire that are relevant to this analysis were based on theoretical perspectives provided by Merton (1957) on norms of research, Mitroff (1974) on counternorms of research, Victor and Cullen (1988) on ethical climates, and Van

Maanen and Schein (1979) on socialization. The questionnaire was pretested on groups of students in the sciences, social sciences, and engineering.

The questionnaires were mailed to our student sample in November, 1990. They were coded by discipline and by institution, but not by individual respondent. The sensitive nature of some of the items on the survey made it imperative to insure our respondents' confidentiality; consequently, each questionnaire packet contained a separate postcard by which the student could notify us that he or she had returned the questionnaire, without having that information linked in any way to the questionnaire itself. Two weeks after the initial mailing, we sent out reminder postcards, and after three more weeks, we sent out a second set of complete questionnaire packets to non-respondents. Our follow-up procedures produced an overall response rate of 74 percent. Our adjusted response rate (number of respondents, divided by the total sample less the number of masters and first year student respondents) was 72 percent.[5]

Definition of Variables

The focal variables for this analysis are subscription to the norms of academic research, as described by Merton, and subscription to counternorms, based on Mitroff's work. The relevant items from the questionnaire are presented in Figure 2.

Insert Figure 2 about here

Note that the counternorm items are not merely the negatives of the norms. Rather, they represent alternative, albeit opposing, norms which we assume some academic researchers find not only reasonable, but desirable.

Respondents were asked to indicate the extent to which they personally feel each item should represent the behavior of researchers in their field.[6] Responses were coded as follows: to a great extent (3), to some extent (2), very little or not at all (1).

Subscription to the norms of academic research ("NORMS") was computed for each student as the sum of the coded responses for the four items representing Merton's norms. The range for this variable is therefore 4 to 12. Subscription to Mitroff's counternorms ("COUNTERNORMS") was computed in the same way, using appropriate items.

Most of the independent variables in this analysis relate to departmental climate, departmental structure, and mentoring. The climate variables are scales derived from a factor analysis (principal components analysis, with varimax rotation) of a set of climate-related items. Each scale is the sum, with unit weights, of a set of variables identified by the factor analysis as loading heavily on a given factor. The structure and mentor variables were constructed in the same way. The climate, structure, and mentor variables, along with their component items, are presented in the Appendix.

One additional independent variable is the number of years the student has been in his or her graduate program. Our sampling

procedure ensured that each respondent had been in his or her department for at least one year.

Gender, citizenship status, and academic field are used here as control variables. Thirty-six percent of our respondents are female, and 35 percent are not U.S. citizens. Twenty-seven percent are in chemistry, 22 percent in civil engineering, 26 percent in microbiology, and 25 percent in sociology.

Analytical Approach

We first employ descriptive statistics to measure the extent to which students subscribe to academic norms and alternative counternorms. Simple t-tests, oneway analyses of variance, and chi-squared tests demonstrate patterns of adherence to the norms and counternorms across disciplines and other groups.

Then we examine the relationship between subscription to norms and counternorms and departmental characteristics through regression analyses. Here, we control for student gender, citizenship status, and disciplinary field.

Descriptive Results

We first examine the degree to which students subscribe to the norms and alternative counternorms of academic research. As explained above, each student's "norm score" is computed as the sum of his or her response levels to the Mertonian norm items; each counternorm score is computed in a similar way. Since these scores then range between 4 and 12, we adjusted the scores so they would

range between 0 and 100, for interpretability's sake. We applied the linear transformation

$$y = 12.5x - 50,$$

where x is the original score, and y is the adjusted score. The means of these scores for the entire sample and for various subgroups are presented in Table 1.

Insert Table 1 about here

Overall, there is stronger support for the norms than for the counternorms. Subscription to the norms is not universal, however, and subscription to the counternorms is substantial. On the 0 to 100 scale, the average norm score is 84 and the average counternorm score is 49.

Table 1 shows differences in average scores between women and men, between U.S. and international students, and across the four disciplinary fields. All differences in the mean scores are significant at the .01 level, according to analyses of variance performed on the means. Women and U.S. citizens are more likely to subscribe to the norms and less likely to subscribe to the counternorms. Civil engineering students show the weakest support for the norms and the strongest support for the counternorms. Microbiology students support the norms to the greatest extent, while sociology students show the least support for the counternorms.

To disaggregate the norm and counternorm scores, we present a breakdown of measures of subscription in Table 2. The table

Insert Table 2 about here

entries are the percentages of students who indicated strong support for each of the norms and counternorms. To measure the significance of differences across student groups, chi-square tests of the proportionality of responses across those groups were performed, and significant differences are noted in the table.

The norm of organized skepticism (concerning scientists' attention to all evidence, whether or not it challenges their own work) received the strongest support overall: 87 percent of the students strongly support this norm. Among the Mertonian norms, universalism (evaluating research only on its own merit) received the weakest support, approved by only 62 percent. Interestedness (competition for funding and recognition) was most strongly supported among the counternorms (30 percent), and solitariness (protecting new findings) and organized dogmatism (investing one's career in his or her own most important findings) were strongly approved by 24 and 20 percent of the students, respectively.

Women and U.S. students show stronger support for every norm and weaker support for every counternorm than men and international students do. Of particular interest is the significantly greater support for the counternorms on the part of international students. The proportions of international students strongly supporting the counternorms organized dogmatism, interestedness, and solitariness range from 38 percent to 40 percent.

Across disciplinary groups, civil engineering students show the weakest support for three of the norms; chemists show the weakest support for the fourth (communality). Microbiologists are particularly supportive of universalism and disinterestedness, while sociologists strongly support communality.

Strong support for the counternorm of interestedness ranges from 20 percent of sociologists to 35 percent of chemists. Students in science and engineering fields show stronger support for all of the counternorms than sociology students do.

Overall, our data document substantial ambivalence about the norms of academic research and considerable support for the alternative counternorms.

Analytical Results

We now turn to the effects of departmental climate and structure, mentoring, and the number of years spent in the department. Table 3 presents the Pearson correlation coefficients for all pairs of variables employed. As expected, the correlation

Insert Table 3 about here

between subscription to the norms and subscription to the counternorms is negative and significant. It is not, however, large in absolute value, indicating substantial overlap of support for the norms and support for the counternorms. International student status has the highest absolute correlation with support for the norms, and it is negative. Similarly, international status is most

highly correlated (positively) with support for the counternorms. The number of years a student has been in the department is positively correlated with support for the norms and negatively correlated with support for the counternorms. Among the structure variables, supportiveness, formality, collectivity, and fixed are positively associated with support for the counternorms, while divestiture is negatively associated with the same variable. Among the climate variables, solidarity is positively correlated with support for the norms, and humaneness is positively related to support for the norms. Individualism has a negative correlation with the counternorm measure. Interestingly, nearly all of the mentoring variables have positive, significant relationships with both the norm and counternorm variables.

Table 4 presents the standardized regression coefficients for the independent variables regressed on support for the norms and counternorms.

Insert Table 4 about here

In each case, the regression results are presented with and without the control variables (gender, citizenship status, and discipline). The independent variables explain a greater proportion of the variance of the counternorms (19 percent) than of the norms (less than 9 percent).

Without the control variables, two structure variables (formality and divestiture) have significant effects on support for the norms, but these effects disappear when the controls are added.

Solidarity (a climate variable) and technical support (a mentoring variable) both show positive effects on support for the norms. The greatest effect on subscription to the norms is from the citizenship variable, and the coefficient is negative.

In the counternorm equations, formality (structure) and competition (climate) both show significant, positive effects, even in the presence of the control variables. International student status shows a positive effect on support for the counternorms, as do all of the disciplinary variables.

The extremely strong effect of the citizenship variable in both the norm and counternorm equations prompted us to examine the U.S. and non-U.S. subgroups separately. The results are in Tables 5 and 6.

Insert Tables 5 and 6 about here.

The levels of explained variance for U.S. students is very low, less than 9 percent in every case. The strongest effects are shown by formality (a positive effect on support for the counternorms) and the discipline variables (all positive effect on the counternorm variable).

More distinct effects, and greater explanatory power, are obtained in the case of non-U.S. students. Collectivity and personal mentoring both show negative effects on support for the norms. Solidarity and technical mentoring have positive effect on subscription to the norms. Formality and collectivity have positive effects on support for the counternorms. The gender variable is marginally significant (and negative) in the counternorm case.

Discussion

The strongest explanatory factor in predicting support for the norms and counternorms is the citizenship status of the student. International students are less likely to subscribe to the Mertonian norms and more likely to subscribe to Mitroff's counternorms. This finding is particularly interesting since 62 percent of the international respondents hope to work in the U.S. after completing their Ph.D. degrees. It suggests that the assumption of universal adherence to the Mertonian norms on the part of U.S. scientists, social scientists, and engineers may be inappropriate, if international Ph.D. recipients come to play a greater role in these disciplines in the U.S.

Among our structure variables, formality and collectivity emerge as the most significant predictors of support for the norms and counternorms. Formality and collectivity's positive effects on the counternorm measure, together with collectivity's negative effect on the norm variable (for international students) may indicate that impersonal, routinized graduate programs in which students work together in large "batches" on research projects, may foster a tendency to subscribe to counternorm standards. These students may simply not have the close one-to-one relationship with a scientist or engineer which is presumed to provide appropriate socialization into the field.

The most important climate variable in this analysis is solidarity, which includes congruence in professional values among the fellow students. This variable has a positive effect on

agreement with the norms, particularly among international students, suggesting that students who work together closely enough to feel a sense of solidarity are more likely to have a sense of each others' values and to share support for the norms of research.

The effects of mentoring are particularly evident in international students' subscription to the norms. Here, technical support has a positive effect, and personal support a negative effect. The technical support students receive may include basic information on how work is done in accordance with the norms of research. Strong personal support may indicate a different kind of mentoring relationship, one which affirms the student's work without emphasis on his or her socialization into the norms of the field.

The number of years a student has spent in a department is an ineffective predictor variable, suggesting that students' views on normative behaviors may not change significantly over the course of a graduate career. Such longitudinal inferences must be may with caution, of course, since our data are cross-sectional in nature.

Finally, disciplinary differences are significant for U.S. citizens, but not for international students. This finding may be an artifact of the uneven distribution of international students across our chosen fields. The disciplinary effects for U.S. students may suggest that the norms, or more accurately the counternorms, do not function with equal potence across all fields, contrary to Burton Clark's observation that the norms constitute an ethos for the academic profession.

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Figure 1: Selection of Academic Fields According to the Biglan Typology.

Pure Fields	Applied Field
Chemistry	Civil Engineering
Microbiology	
Sociology	

Hard Paradigm Fields	Soft Paradigm Field
Chemistry	Sociology
Microbiology	
Civil Engineering	

Life Fields	Non-Life Fields
Microbiology	Chemistry
Sociology	Civil Engineering

Figure 2: Items Used in Constructing NORMS (Subscription to the Norms of Academic Research) and COUNTERNORMS (Subscription to Counternorms)

NORMS:	
Universalism	Scientists evaluate research only on its merit, i.e., according to accepted standards of the field.
Communality	Scientists openly share new findings with all colleagues.
Disinterestedness	Scientists are motivated by the desire for knowledge and discovery, and not by the possibility of personal gain.
Organized Skepticism	Scientists consider all new evidence, hypotheses, theories, and innovations, even those that challenge or contradict their own work.
COUNTERNORMS:	
Particularism	Scientists assess new knowledge and its applications based on the reputation and past productivity of the individual or research group.
Solitariness	Scientists protect their newest findings to ensure priority in publishing, patenting, or applications.
Interestedness	Scientists compete with others in the same field for funding and recognition of their achievements.
Organized Dogmatism	Scientists invest their careers in promoting their own most important findings, theories, or innovations.

Table 1: Adjusted Means of Students' Subscription to the Norms and Counternorms of Academic Research.

	Norms	Counternorms
All	84	49
Men	83 **	52 **
Women	86	45
US Citizens	86 **	44 **
Non-US Citizens	79	59
Chemistry	84 **	52 **
Civil Engineering	79	53
Microbiology	87	51
Sociology	84	41

** = F-test associated with analysis of variance of the given variable across the given group is significant at the .01 level.

Table 2: Percentage of Students Who Responded That They Personally Feel **to a Great Extent** That the Norm or Counternorm Indicated Should Represent the Behavior of Scientists

	NORMS				COUNTERNORMS			
	Univer.	Commun.	Disint.	Org. Skept.	Partic.	Solitar.	Inter.	Org. Dogmat.
All	62	73	71	87	12	24	30	20
Men	62	72	66**	85*	14	26*	32*	23**
Women	62	75	79	90	10	20	25	16
US Citizens	70**	75	71	90**	8**	15**	24**	10**
Non-US Citizens	46	70	69	81	21	40	39	38
Chemistry	63**	64**	72**	91**	13	31**	35**	21*
Civil Engineering	50	74	61	81	16	22	30	22
Microbiology	71	74	77	90	12	24	32	22
Sociology	60	81	71	84	9	18	20	15

NORMS: Universalism
Communality
Disinterestedness
Organized Skepticism

COUNTERNORMS: Particularism
Solitariness
Interestedness
Organized Dogmatism

* = Chi-Square test across given group is significant at the .05 level.
** = Chi-Square test across given group is significant at the .01 level.

Table 3: Correlation Coefficients

	NORMS	CNORMS	FEMALE	INTERNAT	YEARS	CHEM	CIVIL	MICRO	SUPPORT	FORMAL	DIVEST
NORMS	1.0000	-.0744**	.0835**	-.1933**	.0387	.0083	-.1487**	.1244**	.0334	-.0679*	.0577*
CNORMS	-.0744**	1.0000	-.1347**	.3185**	-.0961**	.0808**	.0866**	.0364	.1022**	.2613**	-.0937**
FEMALE	.0835**	-.1347**	1.0000	-.1700**	.0671*	-.1027**	-.2497**	.1162**	-.0238	-.1714**	.1321**
INTERNAT	-.1933**	.3185**	-.1700**	1.0000	-.0931**	-.0646*	.2769**	-.0647*	-.0197	.3521**	-.1095**
YEARS	.0387	-.0961**	.0671*	-.0931**	1.0000	-.0401	-.0806**	-.0505	-.1114**	-.2063**	.0884**
CHEM	.0083	.0808**	-.1027**	-.0646*	-.0401	1.0000	-.3202**	-.3591**	-.0244	-.0888**	.0648*
CIVIL	-.1487**	.0866**	-.2497**	.2769**	-.0806**	-.3202**	1.0000	-.3161**	-.0186	.2267**	-.1399**
MICRO	.1244**	.0364	.1162**	-.0647*	-.0505	-.3591**	-.3161**	1.0000	.0616*	.0009	.0280
SUPPORT	.0334	.1022**	-.0238	-.0197	-.1114**	-.0244	-.0186	.0616*	1.0000	.4011**	-.4596**
FORMAL	-.0679*	.2613**	-.1714**	.3521**	-.2063**	-.0888**	.2267**	.0009	.4011**	1.0000	-.4161**
DIVEST	.0577*	-.0937**	.1321**	-.1095**	.0884**	.0648*	-.1399**	.0280	-.4596**	-.4161**	1.0000
COLLECT	.0095	.1274**	-.0901**	.0373	-.1129**	.1853**	-.1163**	.1507**	.0971**	.1501**	-.0303
CONTACT	.0553*	-.0168	.0017	-.2296**	-.0282	.1442**	-.0527*	-.0084	.1421**	.0294	-.1287**
SELFDIR	.0456	-.0078	.0348	-.1136**	.0084	-.0501	-.0224	-.0069	.1449**	.0975**	-.1108**
FIXED	.0003	.1039**	-.0222	.0636*	-.0915**	.1525**	.0109	.0552*	.0221	.0725**	.0348
HUMANE	.0135	.1167**	-.0461	.0300	-.1645**	-.0254	.0635*	.0450	.4890**	.5000**	-.5385**
COMPET	-.0470	-.0448	.0801**	-.0200	.1195**	-.1351**	.0260	-.1556**	-.3564**	-.2941**	.3575**
SOLIDAR	.1061**	.0103	.0367	-.1787**	-.0145	.0745**	-.0486	.0324	.2033**	.1182**	-.1649**
EXPLOIT	-.0069	-.0469	.0211	.0030	.0831**	.0263	-.0180	-.0238	-.2902**	-.2418**	.4279**
INDIV	-.0486	-.1095**	.0769**	.0227	.1857**	-.1962**	-.0227	-.1777**	-.2678**	-.1991**	.2455**
TECHNIC	.0993**	.0852**	.0111	-.0517	-.0864**	-.0126	-.0673*	.1184**	.6803**	.3343**	-.3516**
STRATEG	.0951**	.0706**	.0098	-.0771**	.0163	.0495	-.0467	.1218**	.5320**	.2165**	-.2862**
PERSONAL	.0215	.0774**	.0634*	.0270	-.0119	-.0914**	.0224	.0287	.4596**	.2787**	-.2834**

* = significant at the .05 level
** = significant at the .01 level

Table 3: Correlation Coefficients (continued)

	COLLECT	CONTACT	SELFDIR	FIXED	HUMANE	COMPET	SOLIDAR	EXPLOIT	INDIV	TECHNIC	STRATEG	PERSONAL
NORMS	.0095	.0553*	.0456	.0003	.0135	-.0470	.1061**	-.0069	-.0486	.0993**	.0951**	.0215
CNORMS	.1274**	-.0168	-.0078	.1039**	.1167**	-.0448	.0103	-.0469	-.1095**	.0852**	.0706**	.0774**
FEMALE	-.0901**	.0017	.0348	-.0222	-.0461	.0801**	.0367	.0211	.0769**	.0111	.0098	.0634*
INTERNAT	.0373	-.2296**	-.1136**	.0636*	.0300	-.0200	-.1787**	.0030	.0227	-.0517	-.0771**	.0270
YEARS	-.1129**	-.0282	.0084	-.0915**	-.1645**	.1195**	-.0145	.0831**	.1857**	-.0864**	.0163	-.0119
CHEM	.1853**	.1442**	-.0501	.1525**	-.0254	-.1351**	.0745**	.0263	-.1962**	-.0126	.0495	-.0914**
CIVIL	-.1163**	-.0527*	-.0224	.0109	.0635*	.0260	-.0486	-.0180	-.0227	-.0673*	-.0467	.0224
MICRO	.1507**	-.0084	-.0069	.0552*	.0450	-.1556**	.0324	-.0238	-.1777**	.1184**	.1218**	.0287
SUPPORT	.0971**	.1421**	.1449**	.0221	.4890**	-.3564**	.2033**	-.2902**	-.2678**	.6803**	.5320**	.4596**
FORMAL	.1501**	.0294	.0975**	.0725**	.5000**	-.2941**	.1182**	-.2418**	-.1991**	.3343**	.2165**	.2787**
DIVEST	-.0303	-.1287**	-.1108**	.0348	-.5385**	.3575**	-.1649**	.4279**	.2455**	-.3516**	-.2862**	-.2834**
COLLECT	1.0000	.1152**	.0069	.0833**	.1562**	-.1332**	.0912**	-.0918**	-.2360**	.1895**	.2418**	.0423
CONTACT	.1152**	1.0000	.0394	.0265	.2230**	-.2049**	.2885**	-.1263**	-.1973**	.1472**	.1565**	.0687*
SELFDIR	.0069	.0394	1.0000	-.0445	.1938**	-.0940**	.1400**	-.1240**	-.0130	.1169**	.1025**	.1052**
FIXED	.0831**	.0265	-.0445	1.0000	.0031	-.0322	.0683*	.0370	-.0879**	-.0046	.0028	-.0244
HUMANE	.1562**	.2230**	.1938**	.0031	1.0000	-.5010**	.2992**	-.3933**	-.3661**	.4236**	.3682**	.3363**
COMPET	-.1332**	-.2049**	-.0940**	-.0322	-.5010**	1.0000	-.1679**	.3213**	.3963**	-.2847**	-.2722**	-.1337**
SOLIDAR	.0912**	.2885**	.1400**	.0683*	.2992**	-.1679**	1.0000	-.0646*	-.1756**	.1891**	.1503**	.0972**
EXPLOIT	-.0918**	-.1263**	-.1240**	.0370	-.3933**	.3213**	-.0646*	1.0000	.1874**	-.2310**	-.2533**	-.1599**
INDIV	-.2360**	-.1973**	-.0130	-.0879**	-.3661**	.3963**	-.1756**	.1874**	1.0000	-.2633**	-.2718**	-.1486**
TECHNIC	.1895**	.1472**	.1169**	-.0046	.4236**	-.2847**	.1891**	-.2310**	-.2633**	1.0000	.7136**	.6205**
STRATEG	.2418**	.1565**	.1025**	.0028	.3682**	-.2722**	.1503**	-.2533**	-.2718**	.7136**	1.0000	.5388**
PERSONAL	.0423	.0687*	.1052**	-.0244	.3363**	-.1337**	.0972**	-.1599**	-.1486**	.6205**	.5388**	1.0000

* = significant at the .05 level
** = significant at the .01 level

Table 4: Standardized Regression Coefficients for Norms and Counternorms, Regressed on Climate and Structure Variables, Mentoring Variables, Years in Graduate Program, and Control Variables.

	Norms		Counternorms	
Structure:				
Support	-.0127	-.0289	-.0132	.0225
Formality	-.1045**	-.0156	.2623**	.1471**
Divestiture	.0865*	.0537	-.0510	-.0242
Collectivity	-.0420	-.0336	.1069**	.0510
Contact	.0128	-.0121	-.0565	-.0024
Self-Direction	.0297	.0093	-.0426	-.0088
Fixed	-.0134	-.0061	.0657*	.0339
Climate:				
Humane	.0148	-.0020	-.0223	.0183
Competition	-.0497	-.0513	.0333	.0933**
Solidarity	.0991**	.0770*	-.0178	.0192
Exploitation	-.0065	.0038	.0107	-.0061
Individualism	-.0152	-.0129	-.0325	.0031
Mentor:				
Technical	.1424**	.1056*	-.0222	.0101
Strategic	.0574	.0586	.0354	.0228
Personal	-.0584	-.0572	-.0058	.0069
Years	.0365	.0267	-.0395	-.0158
Female		.0294		-.0515
International		-.1583**		.2808**
Chemistry		-.0559		.1959**
Civil Engineering		-.0727		.0820*
Microbiology		.0456		.1667**
R Squared	.0496	.0875	.1069	.1931

* = t-test for individual coefficient is significant at the .05 level
** = t-test for individual coefficient is significant at the .01 level

Table 5: (U.S. Citizens) Standardized Regression Coefficients for Norms and Counternorms, Regressed on Climate and Structure Variables, Mentoring Variables, Years in Graduate Program, and Control Variables.

	Norms		Counternorms	
Structure:				
Support	-.0023	.0023	-.0702	-.0441
Formality	-.0559	-.0481	.1271**	.1253**
Divestiture	.0607	.0528	-.0695	-.0663
Collectivity	.0408	.0393	.0341	.0059
Contact	-.0247	-.0162	.0019	-.0059
Self-Direction	.0026	-.0028	-.0199	-.0209
Fixed	-.0300	-.0336	.0697	.0354
Climate:				
Humane	.0551	.0543	-.0768	-.0510
Competition	-.0291	-.0185	.0241	.0908
Solidarity	.0549	.0580	.0332	.0342
Exploitation	.0333	.0414	-.0335	-.0554
Individualism	-.0062	-.0028	-.0825	-.0143
Mentor:				
Technical	.0545	.0372	-.0133	.0141
Strategic	.0190	.0178	.1002	.0528
Personal	.0231	.0174	-.0358	.0000
Years	.0301	.0307	-.0247	-.0104
Female		.0168		-.0172
Chemistry		-.0232		.2644**
Civil Engineering		-.0116		.1556**
Microbiology		.0823		.2086**
R Squared	.0186	.0281	.0486	.0859

* = t-test for individual coefficient is significant at the .05 level
** = t-test for individual coefficient is significant at the .01 level

Table 6: (Non-U.S. Citizens) Standardized Regression Coefficients for Norms and Counternorms, Regressed on Climate and Structure Variables, Mentoring Variables, Years in Graduate Program, and Control Variables.

	Norms		Counternorms	
Structure:				
Support	-.0607	-.0672	.1298	.1080
Formality	.0241	.0581	.1844**	.1908**
Divestiture	.0946	.0652	.0384	.0262
Collectivity	-.1162*	-.1365*	.1587**	.1207*
Contact	-.0200	.0055	-.0328	-.0334
Self-Direction	.0274	.0217	.0154	.0261
Fixed	.0252	.0445	.0437	.0336
Climate:				
Humane	-.0626	-.0858	.0796	.0872
Competition	-.1131	-.1024	.0778	.1034
Solidarity	.1095*	.1206*	.0172	.0178
Exploitation	-.0555	-.0532	.0617	.0578
Individualism	-.0194	-.0477	-.0046	.0163
Mentor:				
Technical	.2456**	.2407*	.0738	.0675
Strategic	.1185	.1305	-.0680	-.0471
Personal	-.1993**	-.1957**	.0100	.0146
Years	.0357	.0173	-.0450	-.0352
Female		.0848		-.1043
Chemistry		-.1138		.0644
Civil Engineering		-.1705*		-.0691
Microbiology		.0093		.0855
R Squared	.0823	.1211	.1440	.1642

* = t-test for individual coefficient is significant at the .05 level
** = t-test for individual coefficient is significant at the .01 level

Footnotes

1. This study is part of the Project on Values and Ethical Issues in the Graduate Education of Scientists and Engineers. The Project is supported by a grant to the Acadia Institute by the National Science Foundation; co-sponsors are the Committee on Scientific Freedom and Responsibility of the American Association for the Advancement of Science, the Council of Graduate Schools, and Sigma Xi.

2. The questionnaires were tailored to each field, where appropriate. Chemists and microbiologists received questionnaires referring to "scientists", whereas civil engineers and sociologists received questionnaires referring to "engineers" and "social scientists", respectively.

3. Our selection of departments, based information in the Directory of Graduate Programs: 1988 & 1989 yielded 100 departments: 30 chemistry departments, 25 civil engineering departments, 21 microbiology departments, and 24 sociology departments.

4. Given our concern with doctoral education as the locus of socialization into the norms and practices of academic research, we surveyed only doctoral, not masters, students.

5. By discipline, our useable response rates were: chemistry, 74 percent; civil engineering, 61 percent; microbiology, 73 percent; and sociology, 70 percent. These were computed as the number of

respondents in a field minus masters and first-year students, divided by 500 (the discipline sample size).

6. In the same battery, students were asked to indicate the extent to which they personally feel the item actually does represent the typical behavior of faculty in their departments. Responses to these items are not used in the present analysis, but will be investigated in subsequent analyses.

Appendix: Scales Derived from Factor Analyses of Structure, Climate, and Mentoring Variables.

STRUCTURE

Support

Is there at least one faculty member (including your advisor, if appropriate) in your department who is particularly supportive of you and your work?
When your work is evaluated, how often do you find the evaluation constructive?
When your work is evaluated, how often do you find the evaluation promptly provided?
When your work is evaluated, how often do you find the evaluation detailed?
I am satisfied with the amount and quality of time spent with my advisor.

Formality

Evaluation of students successfully "weeds out" weak doctoral students.
Faculty members are explicit in their expectations of students.
Teaching assistants are carefully supervised by faculty.
Research assistants are carefully supervised by faculty.
My coursework has laid a good foundation for doing independent work.

Divestiture

When your work is evaluated, how often do you find the evaluation humiliating?
The advice and information I receive from faculty is inconsistent.
Faculty expect my responsibilities as a student to come before all other responsibilities.
Graduate school has positively reinforced my prior values, self-image, and way of thinking about the world (reverse coded).
Graduate school is changing me in ways I do not like.

Collectivity

Most students make presentations at regional or national meetings before graduating.
Most students do their dissertation research as part of a larger, collaborative project.
In a typical week, with how many faculty members, research associates, post-doctoral fellows, and graduate students do you work on research projects?

Contact

Students have little contact with each other (reverse coded).

Self-Direction

Graduate students are encouraged to be self-directed.

Fixed

Most students who enter together tend to complete their degrees at about the same time.
Most students have little choice as to which courses to take because of the number of required courses.

CLIMATE

Humane

Most faculty really care about their teaching.
Faculty make sure that students feel like members of the department.
People put their own interests first (reverse coded).
When conflicts arise, they are resolved quickly.
Students and faculty care about each other.
Graduate students are given an active role in departmental decisions that affect them.

The professional values of my professors are the same as mine.
There are tensions among faculty (reverse coded).
Graduate students are treated with respect.
Faculty seem more concerned with furthering their own careers than with the well-being of the department as a whole (reverse coded).

Competition

People have to compete for departmental resources.
A few students get most of the attention and resources.
Faculty are willing to bend the rules for some students, but not others.
Students have to compete for faculty time and attention.

Solidarity

There is a sense of solidarity among the students who enter the program at the same time.
The professional values of other students in my department are the same as mine.

Exploitation

My graduate assistant obligations are delaying my progress.
I often feel exploited by faculty.

Individualism

Students and faculty collaborate on publications (reverse coded).
This department values individual research over collaborative research.

MENTORING

Technical

Provides helpful criticism on a regular basis.
Teaches me the details of good research practice.
Provides information about on-going research relevant to my work.
Expresses continuing interest in my progress.
Helps me to learn the art of survival in this field.

Strategic

Helps me develop professional relationships with others in my field.
Finds support for me to go to professional meetings.
Assists me in writing for presentations / publications.
Helps me get financial support.
Helps me in locating employment opportunities.
Teaches me to write grant and contract proposals.
Writes letters of recommendation.

Personal

Advises me about teaching.
Provides emotional support when I need it.